(12) UK Patent Application (19) GB (11) 2 037 939 A

(21) Application No 7916070
(22) Date of filing 9 May 1979
(30) Priority data
(31) 2854566
(32) 18 Dec 1978
(33) Fed. Rep. of Germany (DE)
(43) Application published
16 Jul 1980
(51) INT CL³
F16F 15/20//B04B 9/12
F16C 3/02
(52) Domestic classification
F2U 13E
B2P 9A3A 9D1 9G
(56) Documents cited
GB 1447465
GB 1397839
GB 991000
(58) Field of search
B2P
F2S
F2U
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(54) A Coaxial Shaft Arrangement with Means for Damping Shaft Vibration

(57) A composite rotary shaft arrangement e.g. for use in a centrifuge, with means for damping, shaft vibration comprises an inner driven shaft (1) fixedly connected at one end (8) to a coaxial hollow outer driving shaft (7) which is supported by a ball bearing or sliding plain bearing (10) lubricated with an oil mist, and an annular resilient damping member (4) is disposed at an antinode of transverse vibration of the inner shaft, and is housed within an axially-extending portion (9) of the outer shaft. Due to the lack of relative rotational motion between the inner shaft and the outer shaft in the region of the damping member (4), no lubrication of that member is required.

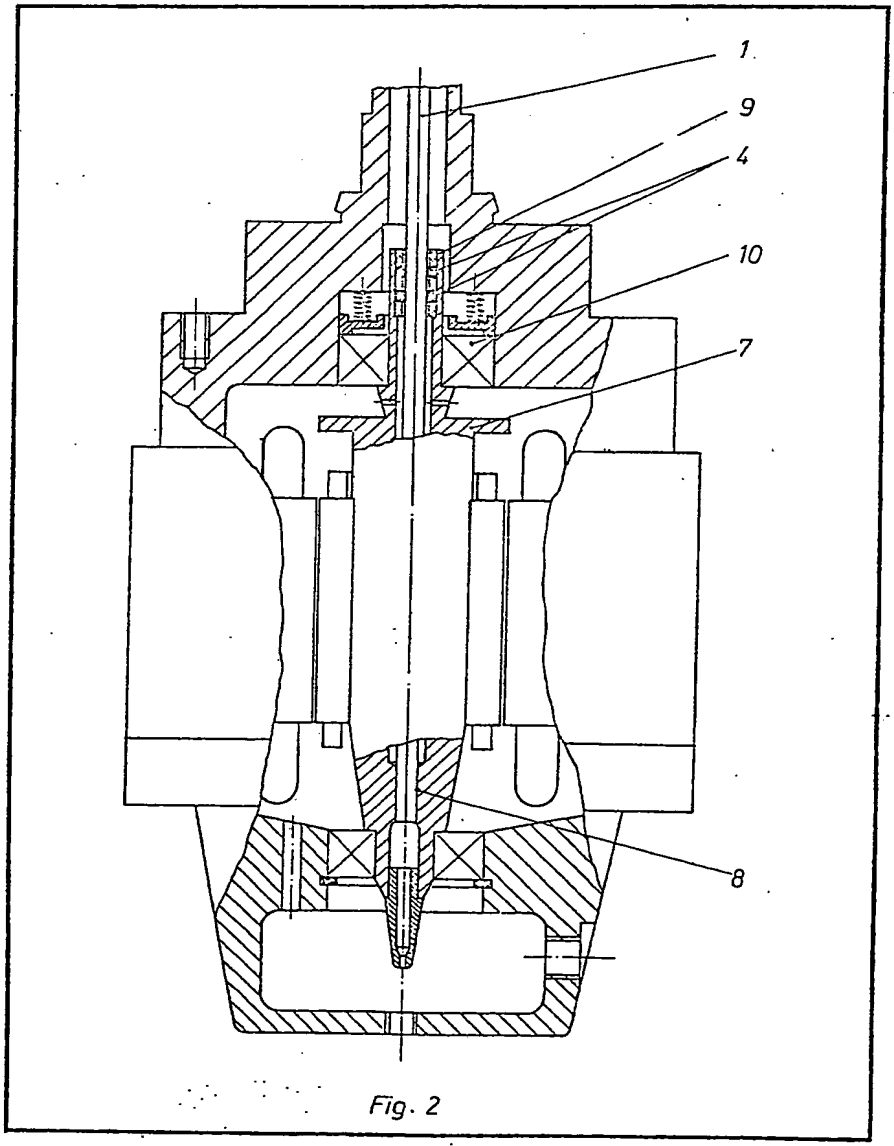

Fig. 2

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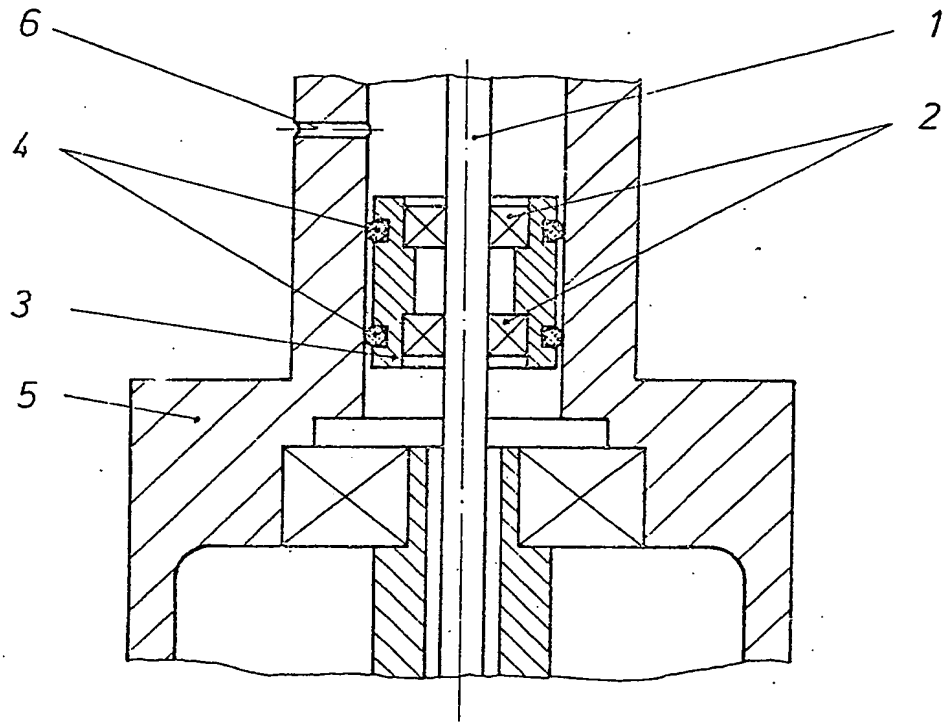

Fig. 1

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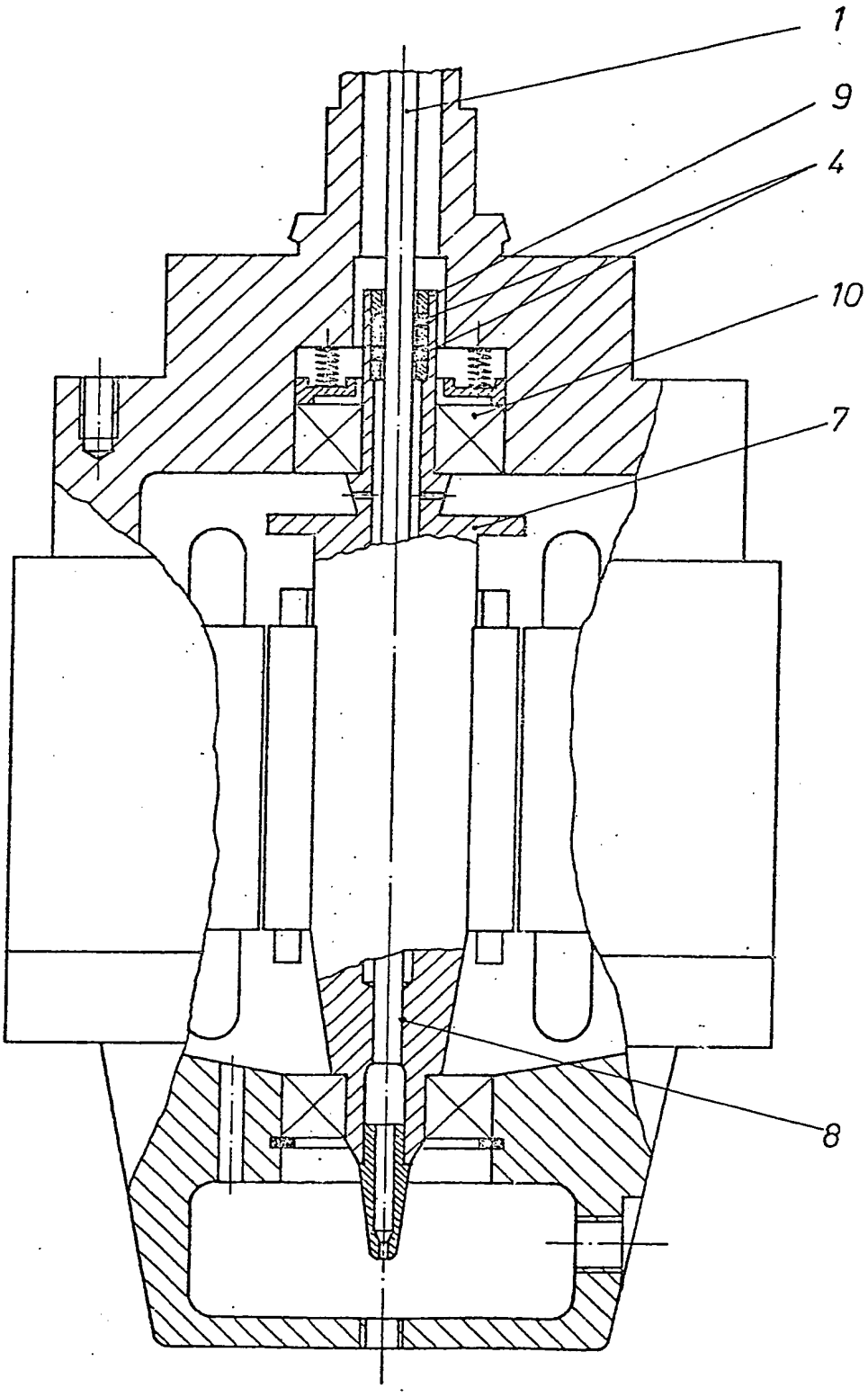

Fig. 2

SPECIFICATION

Bearing Arrangement to Damp Vibrations of a Rotating Spindle

The invention relates to a bearing arrangement to damp vibrations of a rotating spindle, which for force transmission of power is fixedly connected to the drive shaft at one end of the latter which is supported *via* a ball or sliding bearing lubricated with an oil mist, and with a resilient damping member disposed in the vibration antinode of vibration of the spindle.

In the prior art, methods are already known for the vibration-absorbing mounting of a rotating spindle, for example for centrifuges, in which for driving a rotor by a drive shaft the torque is transmitted to a resilient spindle which serves to pick up vibrations at the critical speeds of rotation and for this purpose and to dampen the vibrations, is guided in a sliding or ball-bearing which is supported *via* a rubber-resilient member on the stationary parts of the drive. The vibrations which occur on passage through resonance areas always present on the drive spindle and the high resultant forces make extremely high demands on the ball or sliding bearing used and its essential lubrication. This lubrication, which in the known method of spindle mounting for centrifuges must be positively controlled, can be achieved satisfactorily only with difficulty for all operating conditions of the drive. Damping members mounted on ball or sliding bearings react critically to excessive oil supply because in particular at high speeds, there is a considerable development of heat through the pummeling energy being released at parts which cannot be cooled, which leads to a disintegration of the lubrication film, and the result of this is a carburization of the sliding surfaces until their corrosion.

The problem underlying the present invention is to improve the spindle mounting of the type mentioned at the beginning to obtain a damping out of vibrations of the spindle without oil lubrication.

According to the invention, this problem is solved by supporting the resilient damping member in the drive shaft which is developed in conformity therewith, whereby no location of the damping member, no relative rotational motion requiring lubrication takes place between the drive shaft and the spindle at the locus of the damping member.

The advantage of the invention consists in that by virtue of a mounting of the resilient damping member in the conformably-developed drive shaft, whereby there is no rotational movement between spindle and drive shaft, lubrication of the damping member is not necessary.

A known embodiment of a vibration-damping spindle mounting in centrifuges, and an embodiment according to the invention of a vibration-damping spindle mounting in centrifuges will now be described by way of example with reference to the accompanying drawing in which:

Fig. 1 is a known embodiment of a vibration-damping spindle mounting in centrifuges: and

Fig. 2 is an embodiment according to the invention of a vibration-damping spindle mounting in centrifuges.

In the known spindle mounting shown in Fig. 1; the spindle 1 is supported in the ball bearings 2 which are mounted in a cage 3 which absorbs the vibrations of the spindle 1 through resilient damping members 4 supported on the housing 5. The bearing 2 is lubricated by oil which is force-fed at the point 6 and which runs downwardly over the bearings 2. The amount of oil supplied is very critical because of the fact that the pummeling energy released in the bearing 2 and caused by accumulation of oil leads to a considerable development of heat, particularly at high speeds which can be dissipated only inadequately. The inadequate heat dissipation is due to the fact that the bearing cage 3 is supported thermally insulated in the housing 5 by the resilient damping members 4.

According to Fig. 2 the supporting of the spindle 1 permanently fixed in the drive shaft 7 at the position 8 is effected through a rubber-resilient damping member 4 which in turn is fixed in the upwardly-extended shaft portion 9 as part of the shaft 7. Because of the fixed connection to the spindle 1 at the position 8, there does not occur between the shaft 7 and the spindle 1 in the region of the damping member 4 any rotational movement requiring lubrication when the drive shaft rotates. Mechanical vibrations of the spindle 1 are carried away *via* the resilient mounting 4 to the upwardly-extended portion 9 of the shaft 7, which in turn is supported in known manner *via* an oil-mist lubricated ball bearing 10.

Claims

1. A bearing arrangement to damp vibrations of a rotating spindle which for transmission of power is fixedly connected to the drive shaft at one end of the latter, which is supported *via* a ball or sliding bearing lubricated with an oil-mist, and with a resilient damping element disposed in the antinode of vibration of the spindle and supported within a conformably-developed extension of the drive shaft whereby no relative rotational motion requiring lubrication takes place between the drive shaft and the spindle at the locus of the damping member.

2. A bearing arrangement to damp vibrations of a rotating spindle which for transmission of power is fixedly connected to the drive shaft at one end of the latter which is supported *via* a ball or sliding bearing lubricated with an oil-mist, and with a resilient damping member disposed in the antinode of vibration of the spindle, substantially as hereinbefore described with reference to Fig. 2 of the accompanying drawing.

Printed for Her Majesty's Stationery Office by the Courier Press, Leamington Spa, 1980. Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.